The hot dip galvanizing process

Technical seminar

WEBFORGE

The hot dip galvanizing process

- Loading - jigging
- Degreasing
- Pickling
- Pre-fluxing
- Hot dip galvanizing
- Quenching

The hot dip galvanizing process

Loading - jigging

The steel items need to be supported during the hot dip galvanizing process.

Can the item be easily jigged?
Will touch marks be a problem?

Solutions and molten zinc must be able to flow into all sections and drain off all sections.

Steel items must be designed to prevent air, solutions and molten zinc becoming trapped

Check design for possible problems

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Degreasing

A hot (90^{o}C) caustic bath is used to remove -
Oil, grease, paint another organic compounds

If these contaminating materials are not removed, the next stage of the process (pickling) is affected

Check if any paint is on item - some paints are not easily removed and may require abrasive blasting before galvanizing

Some pipes and pipe fittings have a black varnish coating that cannot be removed in the caustic bath.

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Acid pickling

The steel items are immersed in hydrochloric acid to remove - rust, mill scale and other metal oxides

The steel surface must be perfectly clean of these oxides for the molten zinc to react with the steel

Very heavy rust may not be easily removed by pickling - badly rusted items should be abrasive blasted or mechanically cleaned first.

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Pre-fluxing

Steel items are water rinsed after pickling and immersed in hot (70-80^{o}C) zinc ammonium chloride (ZAC) solution.

The ZAC solution conditions the clean steel surface ready for hot dip galvanizing.

Good pre-treatment = good quality galvanizing

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Quenching

After hot dip galvanized steel item is removed from the galvanizing bath, it is immediately quenched in a sodium dichromate solution

The dichromate quenching cools the item so that it can be quickly handled and passivates the surface of the galvanized coating to maintain its bright appearance.

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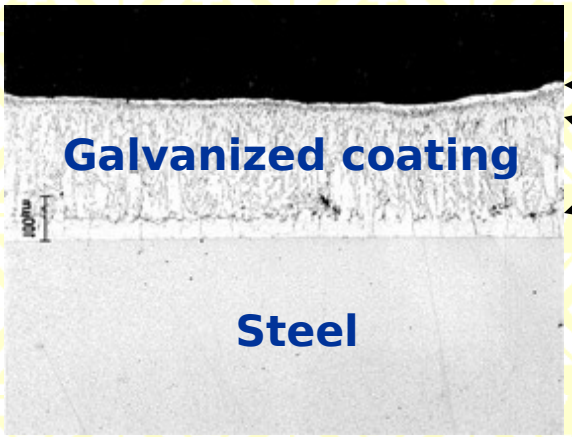
Hot dip galvanizing

The steel is immersed in molten zinc (temp 450^{0}C)

The clean steel surface reacts with the molten zinc to form a zinc-iron alloy which is very strongly bonded to the surface.

The hot dip galvanized coating forms in 3-5 minutes, depending on the steel thickness.



Free zinc layer

Alloy layers

Micrograph - 100 X

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Quenching

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The dichromate quenching cools the item so that it can be quickly handled and conditions the surface of the galvanized coating to maintain its bright appearance.

Dichromate quenching will reduce white rusting problems. White rust forms when rainwater reacts with newly galvanized steel to form zinc hydroxide.

Poor storage or HDG steel will also promote white rust.

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Characteristics

- Typically 65 - 150 microns thick (1 mm = 1000 microns)
- Zinc iron alloy layers make up 80% - 100% of the coating.
- The zinc-iron alloy layers are harder than 250 grade steel

Micrograph of hot dip galvanized coating

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Coating comparisons

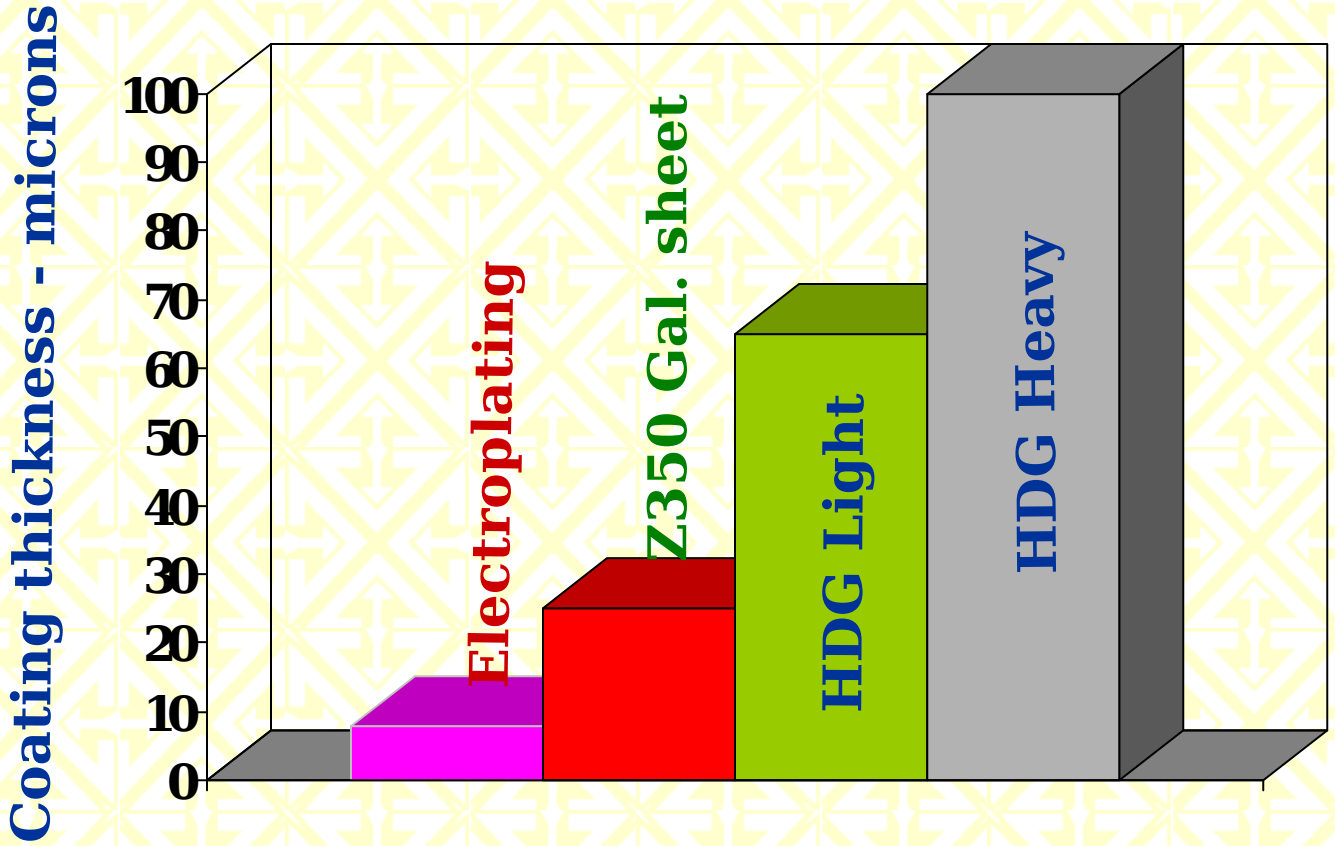
Compared to zinc electroplating (ZEP)and continuous galvanizing (CG), hot dip galvanizing (HDG) is better because…..

- HDG is thicker and will last over 50 years or more without rusting

- HDG is harder and is 5 times more abrasion resistant than ZEP and CG

- HDG coats all external and internal surfaces and edges. All CG coatings have cut, exposed edges after processing.

Coating thickness of coatings on galvanized products



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Zinc cost versus surface area versus zinc pickup

Zinc price 2.00/kg

Section thickness - mm	**1**	**2**	**3**	**5**	**5**	**10**	**15**	**20**
Surface area/t - m^2	255	128	85	51	51	26	17	13
Zinc pickup - 450 g/m2	115	57	38	23	23	11	8	6
Cost $/t	**230**	**115**	**77**	**46**	**46**	**23**	**15**	**11**
Zinc pickup - 600 g/m2	153	77	51	31	31	15	10	8
Cost $/t	**306**	**153**	**102**	**61**	**61**	**31**	**20**	**15**
Zinc pickup - 700 g/m2	179	89	60	36	36	18	12	9
Cost $/t	**357**	**179**	**119**	**71**	**71**	**36**	**24**	**18**
Zinc pickup - 800 g/m2	204	102	68	41	41	20	14	10
Cost $/t	**408**	**204**	**136**	**82**	**82**	**41**	**27**	**20**
Zinc pickup - 1000 g/m2	255	128	85	51	51	26	17	13
Cost $/t	**510**	**255**	**170**	**102**	**102**	**51**	**34**	**26**

Good design reduces excessive zinc pick-up